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Influence of Pre-sowing Seed Treatments and Growing Media on Performance of Consecutive Sowing for Constant Production of Fenugreek Microgreens (*Trigonella foenum-graecum* L.) under Shade Net

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

The present investigation was conducted at the College of Horticulture, Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth Dapoli, Dist. Ratnagiri, State-Maharashtra, India in 2023-24. The experiment was laid out in a split-plot design with factorial arrangement having eight treatment combinations and three replications. Factor A comprised two pre-sowing seed treatments: W_1: Water soaking of seed and W_2: without soaking, while, Factor B included four growing media: M_1: Soil + FYM (3:1), M_2: Coarse Sand, M_3: Cocopeat and M_4: Soil + Cocopeat (1:1).

The data recorded during investigation revealed that the pre-sowing seed treatments and media influenced the growth and yield parameters of fenugreek microgreens. Among two pre-sowing seed treatments, W_1 (Water soaking) had superior effect on all growth and yield parameters compared to W_2 (Without soaking). Among various growing media M_4-Soil + Cocopeat (1:1) found superior in some growth parameters like, days for germination (avg. 3.39), yield (avg. 678.20 g/m^2) and maximum number of cycles (avg.13.46). The treatment combination W_1M_4-[Water soaking of seed + Soil + Cocopeat (1:1)] performed better in terms of days to germination (avg. 2.88), days required for harvest (8.33), yield (avg. 1505.57 g/m^2), number of cycles (avg. 15) in 6 months.

Keywords: Fenugreek microgreens; media; seed treatments; growth; yield.

1. INTRODUCTION

Fenugreek (*Trigonella foenum-graecum L.),* an annual leafy vegetable, belongs to the Leguminosae family and is widely farmed in Asia and the Mediterranean region [1]. It is also known as *Methi* (Hindi and Marathi) or Fenugreek (French) [2]. The species name *foenum-graecum*, which translates to "Greek hay," is where the word fenugreek originates [3]. The two species of Trigonella that are economically significant are *T. corniculata,* also known as the Kasuri methi and *T. foenum graecum,* also known as the common methi. It is a slow-growing variety that spends the majority of its vegetative development phase in rosette state [4]. Fenugreek can withstand frost and freezing temperatures and needs a cool climate. Low temperatures are necessary for the crop's early stages in order to promote greater vegetative growth [5].

The term "microgreens" refers to the tiny, fragile seedlings of several crop species that are either eaten raw or partially cooked. "Microgreens," also known as "Nutrigreens," are young edible greens of many types of vegetables, herbs and plants that are harvested while they are little and full of taste and nutrients. The first pair of genuine leaves are either partly or fully developed, while the cotyledonary leaves have fully expanded. These seedlings are typically described as "green" in hue [6]. Microgreens typically consist of roots, a central stem, two cotyledonary leaves and often the first pair of very young true leaves. Plants are ready for harvesting when they reach a height of approximately 2 to 3 inches (5 to 7.5 cm), typically 10 to 14 days after germination [7].

The concentration of nutrients in microgreens is greater than that of mature herbs and vegetables. Microgreens have 40 times the amount of some vitamins, such as vitamin E, that mature plants do. They are rich source of minerals such as K, Fe, Zn, Mg and Cu [8]. Microgreens are generally thought to be a high source of lutein, violaxanthin, α-carotene and β-carotene.

It is possible to enhance yield and yield-related attributes by combining the right growth medium with pre-sowing seed treatments. Since fenugreek microgreens are cultivated indoors on a large scale, you can grow them year-round at home with the ideal growth medium and climate under supervision. These imply that they are solely impacted by the environment you provide. Consuming microgreens instead of mature leafy vegetables has gained appeal and increased awareness in recent years. It takes 7 to 14 days for fenugreek microgreens to grow from seed to

harvest. Farmers don't need to wait a whole season or longer for harvesting.

When growing fenugreek microgreens outside, gardeners typically utilize soil medium, which can lead to damping off or root rot issues. Growers frequently experience damping off, which is brought on by the pathogen *Rhizoctonia solani* [9]. *Rhizoctonia solani* attacks seedlings at the base, causing them to finally die. Heavy soils that hold on to a lot of moisture cause damping off and other problems. Therefore, in order to solve this issue and achieve the highest possible level of subsequent cycles of fenugreek microgreen production, it is necessary to choose the best growth medium.

Microgreens are an annual crop that farmers may cultivate to supplement their income and provide variety to their business. Therefore, choosing the right growing medium and applying a pre-sowing seed treatment are essential for boosting growth.

2. MATERIALS AND METHODS

The field experiment was carried out at the College of Horticulture, Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli during the year 2023-24. There were two factors and total 8 treatment combinations replicated three times using the split plot design. Factor A is composed of two factors concerned with pre-sowing seed treatments: W_1: Water soaking of seed; W_2: Without soaking, whereas Factor B is composed of four media: M_1: Soil + FYM (3:1), M_2: Coarse sand, M_3: Cocopeat and M_4: Soil + Cocopeat (1:1). The 8 treatment combinations are as follows: W_1M_1- Water soaking of seed + Soil + FYM (3:1), W_1M_2- Water soaking of seed + Coarse sand, W_1M_3- Water soaking of seed + Cocopeat, W_1M_4-Water soaking of seed + Soil + Cocopeat (1:1), W_2M_1- Without soaking + Soil + FYM (3:1), W_2M_2- Without soaking + Coarse sand, W_2M_3- Without soaking + Cocopeat, W_2M_4- Without soaking + Soil + Cocopeat (1:1). The Fenugreek seeds were soaked in water for overnight and the seeds were treated with 10 g/kg of boric acid prior to sowing. After seed treatment, the watersoaked and without soaked seeds were sown on the beds incorporated with different growing media at 10–15 cm distance between two lines. Seeds were carefully covered with the thin layer of media after sowing at 2 cm depth. Regular irrigation was given. The microgreens are harvested within 8–12 days, when their cotyledon leaves are fully opened, with or without emergence of the first pair of true leaves. The consecutive sowings were done for six months. Total 5 plants from each treatment were randomly selected as observational plants to record the observations at time of harvesting. The observations are recorded on different growth parameters like days required for germination, height of seedlings (cm) and yield parameters like days required for harvest, number of cycles and yield (g/m^2).

3. RESULTS AND DISCUSSION

3.1 Days Required for Germination

The data presented in Table 1 recorded the significant effect of pre-sowing seed treatments and media on the number of days required for germination of fenugreek microgreens throughout the experiment. The minimum days required for germination was reported in W_1 (Water soaking) in the month of October (3.13 days), November (3.17 days), December (3.17 days), January (3.17 days), February (3.29 days) and March (3.29 days), while maximum number of days were found in W_2 (Without soaking)) in the month of October (3.96 days), November (3.96 days), December (3.96 days), January (3.96 days), February (4.08 days) and March (4.08 days). Soaking the seeds accelerated germination by a high percentage of emergence in a shorter amount of time, Ponnuswamy and Vijayalakshmi [10]. According to Jamil et al. [11], *cv*. Fasalabad Long required a minimum of 5.77 days to emerge when seeds were soaked for 16 hours, followed by 12 hours (5.88 days). Parallel results were noted in cucumber by Shakuntala et al. [12], Saleem et al. [13] in bitter gourd. The growing media showed early germination in M_4 [Soil + Cocopeat (1:1)], in the month of October (3.33 days), November (3.33 days), December (3.33 days), January (3.33 days), February (3.50 days) and March (3.50 days). In tomato seedlings, cocopeat + soil (1:1) had the maximum germination percentage (94.17 %) within 14 days, according to Panthi et al. [14]. Archana and Lal [15] found that the minimum number of days required for germination is 9 to 11 days when mung beans are grown in cocopeat medium. Similar results were also reported by Priyadarshini and Kumari [16] in onion microgreens. In case of interaction however the late germination was noted in M_2 (Coarse sand) *viz*., in October (3.92 days), November (3.92 days), December (3.92 days), January (3.92 days), February (4 days) and March (4 days). In case of interaction of pre-

sowing seed treatments and media, the minimum number of days required for germination was observed in W_1M_4 [Water soaking of seed + Soil + Cocopeat (1:1)] such as in October (2.83 days), November (2.83 days), December (2.83 days), January (2.83 days), February (3 days) and March (3 days). The W_1M_4 [Water soaking of seed + Soil + Cocopeat (1:1)] required minimum number of days to germinate. This might be attributed to the fact that the hydrolysis of the complex results in simple sugars, which are easily used in the production of auxins and proteins. In order to promote growth and the proteins that are easily used in the creation of new tissues, the auxins that are thus created aid in softening cell walls. As a result, soaking the seeds accelerated germination by a high percentage of emergence in a shorter amount of time Ponnuswamy and Vijayalakshmi [10] in W_1 (Water soaking of seed), however the media M_4 [Soil + Cocopeat (1:1)] had sufficient nutrient, moisture and aeration availability which was responsible for the minimum days for germination found in W_1M_4.

Seedling height (cm): The data presented in Table 2. reported that the maximum seedling height of fenugreek microgreens in M_3 (Cocopeat) *viz.,* in October (5.03 cm), November (5.18 cm), December (5.88 cm), January (5.52 cm), February (5.29 cm) and March (4.97 cm), while the minimum was found in M_2 (Coarse sand) *i.e.*, October (4.50 cm), November (4.67 cm), December (4.84 cm), January (4.78 cm), February (4.72 cm) and March (4.16 cm). Arya and Kutty [17] observed that the maximum height was 5.8 cm in amaranth in cocopeat medium. Reshma and Sarath [18] reported the maximum seedling height (69.36 cm) of tomato in cocopeat medium. In interaction maximum seedling height was recorded in W_1M_3 (Water soaking of seed + Cocopeat) *i.e.,* in October (5.04 cm), November (5.20 cm), December (5.88 cm), January (5.53 cm), February (5.30 cm) and March (4.98 cm), however the lowest was noted in W_2M_2 (Without soaking + Coarse sand) *i.e*., October (4.49 cm), November (4.74 cm), December (4.83 cm), January (4.77 cm), February (4.70 cm) and March (4.14 cm). The highest seedling height was recorded in W_1M_3 (Water soaking of seed + Cocopeat) it might be due to the soaked seeds germinate more quickly and consistently, which resulted in more vigorous development and possibly taller seedling. Similarly as Cocopeat is more porous, providing better aeration and drainage which might have improved uptake of nutrients.

Days required for harvest: The data presented in Table 3 revealed that the minimum number of days required for harvest was recorded in W_1 (Water soaking of seed) in the month of October (8.79 days), November (8.83 days), December (8.67 days), January (8.79 days), February (9.52 days) and March (9.63 days), while maximum number of days required for harvest were found in W_2 (Without soaking)) in the month of October (9.71 days), November (9.46 days), December (9.50 days), January (9.63 days), February (10.42 days) and March (10.42 days). The Fenugreek showed early harvesting in growing media M_4 [Soil + Cocopeat (1:1)], in the month of October (8.75 days), November (8.50 days), December (8.50 days), January (8.67 days), February (9.50 days) and March (9.42 days). In case of interaction the late harvesting was noted in M_2 (Coarse sand) *viz*., in October (10.25 days), November (10.17 days), December (10 days), January (10.17 days), February (11.08 days) and March (11.17 days). Sinha and Thilakacathy [19] found that the minimum days (8) required for harvest in fenugreek and amaranthus microgreen with coco pith medium. Dalal et al. [20] noted the minimum 7 days required for first true leaves in carrot and spinach microgreens noted in cocopeat and rice husk (1:1). In case of interaction of pre-sowing seed treatments and media, the minimum number of days required for harvest was observed in W_1M_4 [Water soaking of seed + Soil + Cocopeat (1:1)] such as in October (8 days), November (8 days), December (8 days), January (8 days), February (9 days) and March (9 days), while maximum number of days for harvest was noted in W_2M_2 (Without soaking + Coarse sand) *i.e*., in October (10.50 days), November (10.33 days), December (10.50 days), January (10.67 days), February (11.67 days) and March (11.67 days). The data concluded that the treatment combination W_1M_4 [Water soaking of seed + Soil + Cocopeat (1:1)] recorded lowest number of days to harvest. It might be because soaking accelerated the primary stage of growth, while the growing medium promoted continuous growth, which could shorten the time required for harvesting.

Number of cycles per month: Table 4 represents data on the impact of pre-sowing seed treatments and media on fenugreek microgreens. The highest number of cycles was observed in W_1 (Water soaking of seed) *i.e*., avg. 2.29, however the lowest were noted in W_2 (Without soaking) *i.e*., avg. 2.12. The maximum number of cycles per month (avg. 2.45) was reported in M_4 [Soil + Cocopeat (1:1)], while the

minimum (avg. 2.01) were noted in M_2 (Coarse sand). In interaction the maximum number of cycles (avg. 2.61) were observed in W_1M_4 [Water soaking of seed + Soil + Cocopeat (1:1)] and the minimum (avg. 1.97) were reported in W_2M_2 (Without soaking + Coarse sand). Water soaked seeds resulted faster and uniform germination, which might enable quicker establishment and faster initial growth phase of fenugreek microgreens. The media soil + Cocopeat contained higher concentration of N, P, K after Cocopeat along with micro-nutrients, which might be enhanced the availability of essential nutrients for the growth and produced more number of cycles in Soil + Cocopeat compared to other. Therefore, maximum number of cycles per months were noticed in W_1M_4 [Water soaking of seed + Soil + Cocopeat (1:1)].

Yield (g/m^2): The data presented in Table 5 and Fig. 1 reported that the maximum yield was noted in W_1 (Water soaking of seed) *i.e.*, in October (829.92 g), November (484.40 g), December (912.15 g), January (505.65 g), February (853.51 g) and March (483.56 g), however the lowest were noted in W_2 (Without soaking) *i.e.*, in October (458.04 g), November (290.56 g), December (510.42 g), January (350.93 g), February (347.85 g) and March (315.24 g). In growing media maximum yield were found in M_4 [Soil + Cocopeat (1:1)] *i.e.*, in October (1324.14 g), November (725.10 g), December (1505.06 g), January (785.79 g), February (1409.67 g) and March (766.43 g), however the lowest were noted in M_3 (Cocopeat) *i.e.*, in October (101.76 g), November (98.97 g), December (237.20 g), January (158.81 g), February (151.12 g) and March (84.61 g). Archana and Lal (2021) recorded the highest yield (75 %), in soil + cocopeat media in mung bean and adzuki bean microgreens. Priyadarshini and Kumari [16] noticed the highest yield of 7.68 g in cocopeat medium. The outcomes were parallel to those of Arya and Kutty [17] in green gram, Naik et al. [21] in mustard microgreens and Allah et al. [22] in mustard microgreens. In interaction the maximum yield was observed in W_1M_4 [Water soaking of seed + Soil + Cocopeat (1:1)] *i.e.*, in October (1775.22 g), November (977.15 g), December (2196 g), January (946.05 g), February (2202.33 g) and March (936.67 g), however the lowest were noted in W_2M_3 (Without soaking + Cocopeat) *i.e.*, in October (88.22 g), November (65.67 g), December (177.11 g), January (96.43 g), February (122.06 g) and March (64.19 g). The data evident that W_1M_4 [Water soaking of seed + Soil + Cocopeat (1:1)] had a significantly higher yield per m^2. It might be due to the soaking seeds promoted germination and early growth, while Soil + Cocopeat medium provided all essential nutrients and aeration for production of maximum yield.

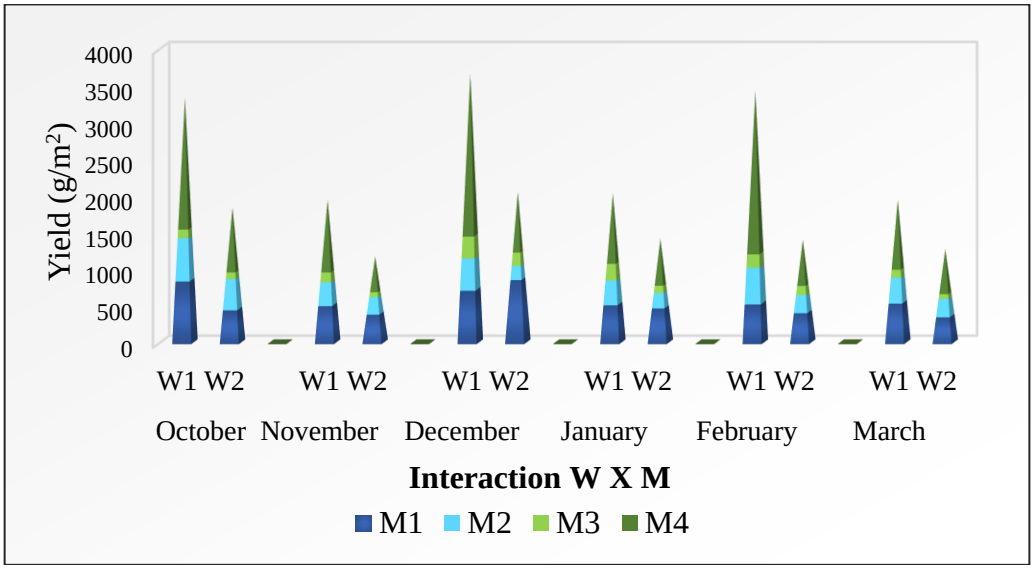

Fig. 1. Effect of pre-sowing seed treatments and media on yield (g/m^2) of fenugreek microgreens

Factor A: Pre-sowing seed treatments
W_1: Water soaking of seed
W_2: Without soaking

Factor B: Growing media
M_1: Soil + FYM (3:1)
M_3: Cocopeat
M_2: Coarse sand
M_4: Soil + Cocopeat (1:1)

Table 1. Monthwise variation in days required for germination of fenugreek microgreens as affected by pre-sowing seed treatments and media

Treatment	October					November					December				
	M_1	M_2	M_3	M_4	Mean	M_1	M_2	M_3	M_4	Mean	M_1	M_2	M_3	M_4	Mean
W_1	3.00	3.83	2.83	2.83	**3.13**	3.00	3.83	3.00	2.83	**3.17**	3.00	3.83	3.00	2.83	**3.17**
W_2	4.00	4.00	4.00	3.83	**3.96**	4.00	4.00	4.00	3.83	**3.96**	4.00	4.00	4.00	3.83	**3.96**
Mean	**3.50**	**3.92**	**3.42**	**3.33**	**3.54**	**3.50**	**3.92**	**3.50**	**3.33**	**3.56**	**3.50**	**3.92**	**3.50**	**3.33**	**3.56**
	S.Em.±		**CD at 5%**		**Result**	**S.Em.±**		**CD at 5%**		**Result**	**S.Em.±**		**CD at 5%**		**Result**
W	0.06		0.16		**SIG**	0.03		0.10		**SIG**	0.03		0.09		**SIG**
M	0.08		0.26		**SIG**	0.08		0.23		**SIG**	0.08		0.23		**SIG**
W X M	0.12		0.36		**SIG**	0.11		0.33		**SIG**	0.11		0.33		**SIG**
Treatment	**January**					**February**					**March**				
	M_1	M_2	M_3	M_4	Mean	M_1	M_2	M_3	M_4	Mean	M_1	M_2	M_3	M_4	Mean
W_1	3.00	3.83	3.00	2.83	**3.17**	3.17	3.83	3.17	3.00	**3.29**	3.17	3.83	3.17	3.00	**3.29**
W_2	4.00	4.00	4.00	3.83	**3.96**	4.17	4.17	4.00	4.00	**4.08**	4.17	4.17	4.00	4.00	**4.08**
Mean	**3.50**	**3.92**	**3.50**	**3.33**	**3.56**	**3.67**	**4.00**	**3.58**	**3.50**	**3.69**	**3.67**	**4.00**	**3.58**	**3.50**	**3.69**
	S.Em.±		**CD at 5%**		**Result**	**S.Em.±**		**CD at 5%**		**Result**	**S.Em.±**		**CD at 5%**		**Result**
W	0.03		0.10		**SIG**	0.08		0.26		**SIG**	0.08		0.26		**SIG**
M	0.08		0.23		**SIG**	0.08		0.26		**SIG**	0.08		0.26		**SIG**
W X M	0.11		0.33		**SIG**	0.12		0.36		**SIG**	0.12		0.36		**SIG**

Factor A: Pre-sowing seed treatments
W_1 : Water soaking of seed
W_2 : Without soaking

Factor B :Growing media
M_1 : Soil + FYM (3:1)
M_2 : Coarse sand
M_3 : Cocopeat
M_4 : Soil + Cocopeat (1:1)

Table 2. Monthwise variation in seedling height (cm) of fenugreek microgreens as affected by pre-sowing seed treatments and media

Treatment	October					November					December				
	M_1	M_2	M_3	M_4	Mean	M_1	M_2	M_3	M_4	Mean	M_1	M_2	M_3	M_4	Mean
W_1	4.84	4.50	5.04	4.91	**4.82**	4.81	4.77	5.20	5.10	**4.97**	4.90	4.84	5.88	5.83	**5.36**
W_2	4.82	4.49	5.01	4.88	**4.80**	4.79	4.74	5.15	5.03	**4.93**	4.86	4.83	5.87	5.78	**5.34**
Mean	**4.83**	**4.50**	**5.03**	**4.90**	**4.81**	**4.80**	**4.76**	**5.18**	**5.06**	**4.95**	**4.88**	**4.84**	**5.88**	**5.80**	**5.35**
	S.Em.±		**CD at 5%**	**Result**		**S.Em.±**		**CD at 5%**	**Result**		**S.Em.±**		**CD at 5%**	**Result**	
W	0.01		-	**NS**		0.01		-	**NS**		0.01		-	**NS**	
M	0.02		0.05	**SIG**		0.01		0.04	**SIG**		0.02		0.05	**SIG**	
W X M	0.02		0.07	**SIG**		0.02		0.06	**SIG**		0.02		0.07	**SIG**	
Treatment	**January**					**February**					**March**				
	M_1	M_2	M_3	M_4	Mean	M_1	M_2	M_3	M_4	Mean	M_1	M_2	M_3	M_4	Mean
W_1	4.90	4.78	5.53	5.38	**5.15**	4.80	4.74	5.30	4.98	**4.96**	4.61	4.17	4.98	4.91	**4.67**
W_2	4.88	4.77	5.50	5.32	**5.12**	4.75	4.70	5.27	4.95	**4.92**	4.58	4.14	4.95	4.86	**4.63**
Mean	**4.89**	**4.78**	**5.52**	**5.35**	**5.13**	**4.78**	**4.72**	**5.29**	**4.97**	**4.94**	**4.59**	**4.16**	**4.97**	**4.89**	**4.65**
	S.Em.±		**CD at 5%**	**Result**		**S.Em.±**		**CD at 5%**	**Result**		**S.Em.±**		**CD at 5%**	**Result**	
W	0.01		-	**NS**		0.01		-	**NS**		0.01		-	**NS**	
M	0.02		0.06	**SIG**		0.01		0.04	**SIG**		0.02		0.05	**SIG**	
W X M	0.03		0.08	**SIG**		0.02		0.06	**SIG**		0.02		0.06	**SIG**	

Factor A: Pre-sowing seed treatments
W_1 : Water soaking of seed
W_2 : Without soaking

Factor B :Growing media
M_1 : Soil + FYM (3:1)
M_2 : Coarse sand
M_3 : Cocopeat
M_4 : Soil + Cocopeat (1:1)

Table 3. Monthwise variation in days required for harvest of fenugreek microgreens as affected by pre-sowing seed treatments and media

Treatment	October					November					December				
	M_1	M_2	M_3	M_4	Mean	M_1	M_2	M_3	M_4	Mean	M_1	M_2	M_3	M_4	Mean
W_1	8.67	10.00	8.50	8.00	**8.79**	8.67	10.00	8.67	8.00	**8.83**	8.67	9.50	8.50	8.00	**8.67**
W_2	9.50	10.50	9.33	9.50	**9.71**	9.50	10.33	9.00	9.00	**9.46**	9.50	10.50	9.00	9.00	**9.50**
Mean	**9.08**	**10.25**	**8.92**	**8.75**	**9.25**	**9.08**	**10.17**	**8.83**	**8.50**	**9.15**	**9.08**	**10.00**	**8.75**	**8.50**	**9.08**
	S.Em.±		**CD at 5%**		**Result**	**S.Em.±**		**CD at 5%**		**Result**	**S.Em.±**		**CD at 5%**		**Result**
W	0.08		0.24		**SIG**	0.05		0.16		**SIG**	0.03		0.10		**SIG**
M	0.11		0.34		**SIG**	0.08		0.23		**SIG**	0.04		0.13		**SIG**
W X M	0.16		0.48		**SIG**	0.11		0.33		**SIG**	0.06		0.18		**SIG**
Treatment	**January**					**February**					**March**				
	M_1	M_2	M_3	M_4	Mean	M_1	M_2	M_3	M_4	Mean	M_1	M_2	M_3	M_4	Mean
W_1	9.00	9.67	8.50	8.00	**8.79**	9.50	10.50	9.07	9.00	**9.52**	9.67	10.67	9.17	9.00	**9.63**
W_2	9.33	10.67	9.17	9.33	**9.63**	10.00	11.67	10.00	10.00	**10.42**	10.17	11.67	10.00	9.83	**10.42**
Mean	**9.17**	**10.17**	**8.83**	**8.67**	**9.21**	**9.75**	**11.08**	**9.53**	**9.50**	**9.97**	**9.92**	**11.17**	**9.58**	**9.42**	**10.02**
	S.Em.±		**CD at 5%**		**Result**	**S.Em.±**		**CD at 5%**		**Result**	**S.Em.±**		**CD at 5%**		**Result**
W	0.03		0.10		**SIG**	0.02		0.07		**SIG**	0.08		0.24		**SIG**
M	0.10		0.32		**SIG**	0.09		0.27		**SIG**	0.09		0.28		**SIG**
W X M	0.15		0.46		**SIG**	0.13		0.39		**SIG**	0.13		0.39		**SIG**

Factor A: Pre-sowing seed treatments
W_1 : Water soaking of seed
W_2 : Without soaking

Factor B :Growing media
M_1 : Soil + FYM (3:1)
M_3 : Cocopeat
M_2 : Coarse sand
M_4 : Soil + Cocopeat (1:1)

Table 4. Monthwise variation in number of cycles per month of fenugreek microgreens as affected by pre-sowing seed treatments and media

Treatment	October					November					December				
	M_1	M_2	M_3	M_4	Mean	M_1	M_2	M_3	M_4	Mean	M_1	M_2	M_3	M_4	Mean
W_1	2.83	2.17	3.00	3.00	**2.75**	2.00	2.00	2.00	2.33	**2.08**	2.08	2.17	3.00	3.00	**2.56**
W_2	2.00	2.00	2.83	2.83	**2.42**	2.00	2.00	2.00	2.00	**2.00**	2.00	2.00	2.57	2.83	**2.35**
Mean	**2.42**	**2.08**	**2.92**	**2.92**	**2.58**	**2.00**	**2.00**	**2.00**	**2.17**	**2.04**	**2.04**	**2.08**	**2.78**	**2.92**	**2.46**
	S.Em.±		**CD at 5%**		**Result**	**S.Em.±**		**CD at 5%**		**Result**	**S.Em.±**		**CD at 5%**		**Result**
W	0.03		0.10		**SIG**	0.03		-		**NS**	0.07		-		**NS**
M	0.07		0.22		**SIG**	0.04		0.13		**SIG**	0.09		0.26		**SIG**
W X M	0.10		0.31		**SIG**	0.06		0.18		**SIG**	0.12		0.37		**SIG**
Treatment	**January**					**February**					**March**				
	M_1	M_2	M_3	M_4	Mean	M_1	M_2	M_3	M_4	Mean	M_1	M_2	M_3	M_4	Mean
W_1	2.00	2.00	2.00	2.33	**2.08**	2.00	2.00	2.17	3.00	**2.29**	2.00	2.00	2.00	2.00	**2.00**
W_2	2.00	2.00	2.00	2.00	**2.00**	2.00	2.00	2.00	2.00	**2.00**	2.00	1.83	2.00	2.00	**1.96**
Mean	**2.00**	**2.00**	**2.00**	**2.17**	**2.04**	**2.00**	**2.00**	**2.08**	**2.50**	**2.15**	**2.00**	**1.92**	**2.00**	**2.00**	**1.98**
	S.Em.±		**CD at 5%**		**Result**	**S.Em.±**		**CD at 5%**		**Result**	**S.Em.±**		**CD at 5%**		**Result**
W	0.03		-		**NS**	0.03		0.09		**SIG**	0.03		-		**NS**
M	0.04		0.13		**SIG**	0.04		0.13		**SIG**	0.04		-		**NS**
W X M	0.06		0.18		**SIG**	0.06		0.18		**SIG**	0.06		-		**NS**

Factor A: Pre-sowing seed treatments
W_1 : Water soaking of seed
W_2 : Without soaking

Factor B: Growing media
M_1 : Soil + FYM (3:1)
M_3 : Cocopeat
M_2 : Coarse sand
M_4 : Soil + Cocopeat (1:1)

Table 5. Monthwise variation in yield (g/m^2) of fenugreek microgreens as affected by pre-sowing seed treatments and media

Treatment	October					November					December				
	M_1	M_2	M_3	M_4	Mean	M_1	M_2	M_3	M_4	Mean	M_1	M_2	M_3	M_4	Mean
W_1	845.17	584.00	115.30	1775.22	**829.92**	510.22	318.19	132.26	977.15	**484.40**	721.30	434.00	297.28	2196.00	**912.15**
W_2	453.37	417.52	88.22	873.06	**458.04**	392.15	231.37	65.67	473.04	**290.56**	859.34	191.11	177.11	814.11	**510.42**
Mean	**649.27**	**500.76**	**101.76**	**1324.14**	643.98	**451.08**	**274.78**	**98.97**	**725.10**	378.48	**790.32**	**312.56**	**237.20**	**1505.06**	711.28
	S.Em.±		**CD at 5%**		**Result**	**S.Em.±**		**CD at 5%**		**Result**	**S.Em.±**		**CD at 5%**		**Result**
W	0.16		0.47		**SIG**	1.08		3.20		**SIG**	1.22		3.75		**SIG**
M	1.53		4.72		**SIG**	1.54		4.75		**SIG**	1.29		3.57		**SIG**
W X M	2.17		6.68		**SIG**	2.18		6.71		**SIG**	1.83		5.53		**SIG**
Treatment	**January**					**February**					**March**				
	M_1	M_2	M_3	M_4	Mean	M_1	M_2	M_3	M_4	Mean	M_1	M_2	M_3	M_4	Mean
W_1	521.62	333.77	221.18	946.05	**505.65**	537.30	494.22	180.19	2202.33	**853.51**	544.26	348.30	105.04	936.67	**483.56**
W_2	477.30	204.45	96.43	625.54	**350.93**	412.15	240.19	122.06	617.00	**347.85**	357.41	243.19	64.19	596.19	**315.24**
Mean	**499.46**	**269.11**	**158.81**	**785.79**	428.29	**474.72**	**367.20**	**151.12**	**1409.67**	600.68	**450.83**	**295.74**	**84.61**	**766.43**	399.40
	S.Em.±		**CD at 5%**		**Result**	**S.Em.±**		**CD at 5%**		**Result**	**S.Em.±**		**CD at 5%**		**Result**
W	4.67		14.05		**SIG**	4.50		13.60		**SIG**	2.06		6.54		**SIG**
M	8.74		26.93		**SIG**	2.75		8.46		**SIG**	4.11		12.65		**SIG**
W X M	12.36		38.09		**SIG**	3.89		11.97		**SIG**	5.81		17.89		**SIG**

Factor A: Pre-sowing seed treatments
W_1 : Water soaking of seed
W_2 : Without soaking

Factor B :Growing media
M_1 : Soil + FYM (3:1)
M_3 : Cocopeat
M_2 : Coarse sand
M_4 : Soil + Cocopeat (1:1)

Table 6. Effect of pre-sowing seed treatments and media on total cycles in 6 month of fenugreek microgreens

Treatment	M_1	M_2	M_3	M_4	Mean
W_1	13.17	11.83	13.83	15.00	**13.46**
W_2	12.00	11.67	13.67	14.00	**12.83**
Mean	**12.58**	**11.75**	**13.75**	**14.00**	**13.15**
	S.Em.±		**CD at 5%**	**Result**	
W	0.05		0.15	**SIG**	
M	0.09		0.28	**SIG**	
W X M	0.13		0.41	**SIG**	

Factor A: Pre-sowing seed treatments
W_1: Water soaking of seed
W_2: Without soaking

Factor B: Growing media
M_1: Soil + FYM (3:1)
M_3: Cocopeat
M_2: Coarse sand
M_4: Soil + Cocopeat (1:1)

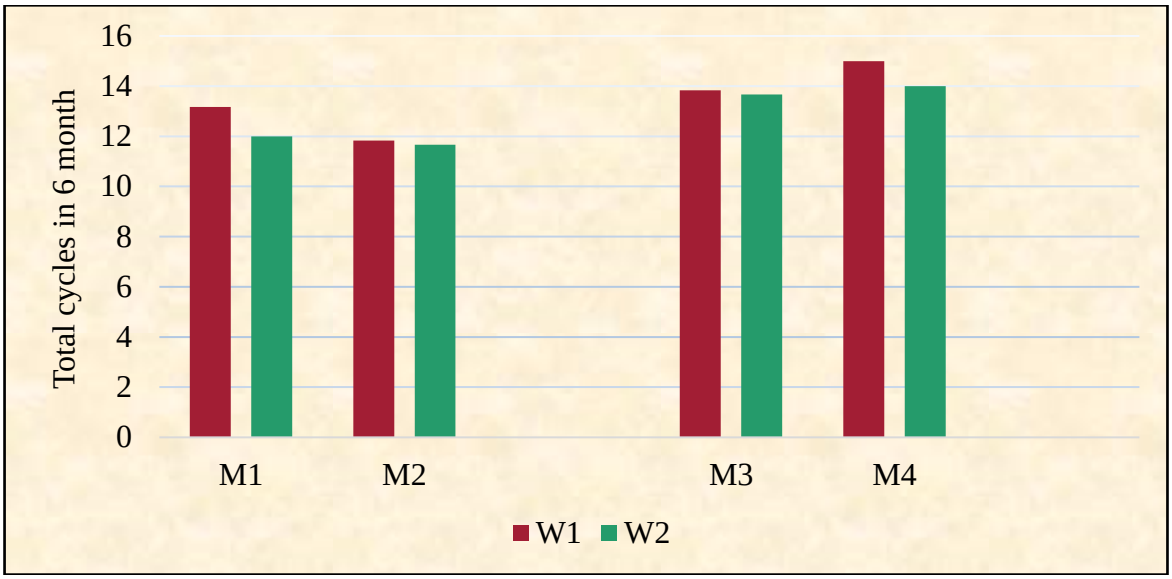

Fig. 2. Effect of pre-sowing seed treatments and media on number of cycles in 6 months

Factor A: Pre-sowing seed treatments
W_1: Water soaking of seed
W_2: Without soaking

Factor B: Growing media
M_1: Soil + FYM (3:1)
M_2: Coarse sand
M_3: Cocopeat
M_4: Soil + Cocopeat (1:1)

Total cycles in 6 month: The data presented in Table 6 and Fig. 2 revealed that the maximum number of cycles in 6 month (13.46) were found in W_1 (Water soaking of seed), while the minimum (12.83) were reported in W_2 (Without soaking). In growing media the maximum number of cycles in 6 months (14) were recorded in M_4 [Soil + Cocopeat (1:1)] and minimum was noted in M_2 (Coarse sand). In case of interaction the maximum number of cycles (15) were noticed in W_1M_4 [Water soaking of seed + Soil + Cocopeat (1:1)] and minimum (11.67) in W_2M_2 (Without soaking + Coarse sand). The data revealed that W_1M_4 [Water soaking of seed + Soil + Cocopeat (1:1)] had the maximum number of cycles in 6 months. This might be due to soaked seeds resulted in faster and uniform germination, which could enabled quicker establishment and faster initial growth phase of fenugreek microgreens. The media Soil + Cocopeat contained higher concentration of N, P, K after Cocopeat along with micro-nutrients might be enhanced the availability of essential nutrients for the growth which produced maximum number of cycles in Soil + Cocopeat compared to other.

4. CONCLUSION

The present study entitled "Influence of pre-sowing seed treatments and growing media on performance of consecutive sowing for constant production of Fenugreek microgreens (*Trigonella foenum-graecum* L.) under shade net" concluded that, W_1 (Water soaking of seed) had positive effect on all growth and yield parameters than the W_2 (Without soaking). Among various growing media, M_4-Soil + Cocopeat (1:1) found superior in some growth parameters like, days for germination, days required for harvest, yield (g/m^2) and more number of harvesting cycles. Ultimately, the treatment combination W_1M_4 [Water soaking of seed + Soil + Cocopeat (1:1)] found superior in most of the growth parameters *viz.,* minimum days for germination, days required for harvest, number of cycles in 6 month and yield g/m^2, however these findings must be verified by repeating the study for two to three seasons.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Authors here by declare that No generative AI technologies such as large language models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of manuscripts.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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